

coloured inks, marginal or thumb indexes, proportional differences, inverse functions, &c. On opening Blackie's "handy" volume, the reader will be disappointed to find that the compiler of the tables has paid little attention to the points enumerated above. A table of six-figure logarithms of four-figure numbers occupies twenty-two pages; the average difference for each row of figures is given, but there is no room found for proportional differences, so that the taking out of the logarithm of a five- or six-figure number involves an irritating calculation. Anti-logarithms are not included, but there is a table of hyperbolic logs. Sixteen pages are allotted to tables of natural and logarithmic functions of angles, for increments of one-sixth of a degree, without differences. Other tables include reciprocals, squares and square roots, cubes and cube roots, circumferences and areas of circles, heights and areas of circular segments, and rhumbs in degrees. There is an appendix giving some simple mensuration rules, some old-fashioned practical geometry, and definitions of the functions of angles, not as ratios, but as lengths.

The German tables are specially suitable for use in the chemical laboratory. The main feature is an eighteen-page table of five-figure logarithms of five-figure numbers, arranged, with proportional differences for each row of figures, like the four-figure logarithms contained in the first two pages. The collection of physical constants at the end is such as a chemist would be likely to require. There are no anti-logarithms, nor is there a marginal index. The size of page is ample, allowing of bold and effective type.

*Second Report on Economic Zoology: British Museum (Natural History).* By Fred. V. Theobald, M.A. Pp. x+197. (London: Printed by Order of the Trustees of the British Museum, 1904.) Price 6s.

THE recent development of British Museum activities in the line of economic zoology, for which the insight of the director is largely to be thanked, is re-expressed in a second report, following quickly on the heels of the first (see NATURE, January 28, 1904, vol. lxi. p. 290). We congratulated Mr. Theobald on his first report, and we repeat our congratulations, for the volume does credit to his energy and ability, and to the expertness of those inside and outside the national museum who have given him assistance. Everyone who has had even a little experience of the amount of work which is often required in order to answer apparently simple questions from outside will appreciate the skill which this report displays. The volume contains a large part of the information furnished by the director of the natural history departments of the British Museum to the Board of Agriculture and Fisheries between November, 1902, and November, 1903, besides replies to other correspondents and some special notes of present-day interest. The British Museum of Natural History is not only one of the greatest world-treasure-houses of scientific material, it has also, in its staff, an almost unrivalled wealth of learning, and we cannot refrain from giving expression to the widespread gratification that these resources of material and knowledge are now being utilised in behalf of the practical queries of the nation. The volume deals with mosquitoes, sheep scab, weevils, aphides, wire-worm, mites, leather-jackets, warbles, ring-worm, liver-fluke, and a hundred other economically interesting pests—and always in a way that leads us to respect Mr. Theobald's wide knowledge and practical shrewdness. We hope that there will be many such reports, for they are of a kind that enrich the nation as well as science. That they also contribute to art may be illustrated by the report on the grubs causing damage at Rye Golf Links.

## LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

### The Heterogenetic Origin of Fungus-germs.

AN attempt has been made in NATURE (December 22, 1904, p. 175), by Mr. George Massee, of Kew, to question the validity of my conclusions because of certain observations of his own of a totally different kind, which have little or no bearing upon what I have brought forward.

What he says is this:—*Dematium pullulans* of de Bary produces exceedingly minute colourless conidia which are most widely distributed and are capable of passing through "thick" filter paper. "Under normal conditions," he adds, "these minute conidia on germination form delicate hyaline hyphæ which give origin to a *Cladosporium*. If cultures of these conidia become infested with bacteria that form *Zoogloea*, the hyphæ become invested with a comparatively thick, brown cell-wall, and form either compact masses of cells or irregular hyphæ consisting of short cells, constricted at the septa, exactly as shown in Dr. Bastian's Fig. 12." He then refers to an illustrated paper in the *Kew Bulletin* for December, 1898, in which he has shown this process as it occurs in a certain disease of *Prunus japonica*. He thinks his observations exactly illustrate some of the facts which I have brought forward, while I, after carefully reading his paper and studying his illustrations, think they are altogether beside the mark.

He supposes the widely distributed conidia are not only present in the hay infusion (which of course they may be), but that they are able to pass through two layers of very fine Swedish filter paper (not merely "thick" paper, as he loosely puts it). Looking to his Fig. 5 and the size of the conidia there shown, this, I think, is more than doubtful. It is, however, altogether immaterial whether such conidia are present in the original hay infusion and are able to pass through the filter used by me or not, because the next necessary step in his suggested explanation is altogether wanting in my observations. This step is that the conidia assumed to be present shall produce delicate hyphæ, and that these hyphæ, coming into contact with masses of *Zoogloea*, shall "become invested with a comparatively thick, brown cell-wall, and form either compact masses of cells or irregular hyphæ consisting of short cells constricted at the septa." But I had already privately assured Mr. Massee that all the phenomena which I have described may be witnessed without its being possible to meet with a single hypha of any kind or a single one of the thick-walled, brown cells to which he refers.<sup>1</sup> Yet for his explanation to have any weight "delicate hyphæ" should always be seen in relation with the *Zoogloea* masses, and as for the "thick-walled cells" which are then formed being exactly like what I have shown in my Fig. 12, I can assure Mr. Massee he is absolutely mistaken. What I have represented in that figure are colourless products of segmentation of a *Zoogloea* mass (wholly unlike the colourless conidia shown in his Fig. 5) which speedily assume a brownish-black colour, and then, *without any intervention of delicate hyphæ*, at once grow out into mycelial filaments of the same colour. In accordance with his explanation, the production of delicate colourless hyphæ should be the commonest thing possible, and should always be met with at an early stage of the changes that I have been describing; but, as a matter of fact, nothing is more remarkable than the rarity with which any of the myriads of Fungus-germs produced in a bacterial scum undergo a further stage of development, with the production of hyphæ either colourless or coloured, and I can assure Mr. Massee that he might work for three weeks or more with such infusions as I have described without finding a single specimen at all comparable with my Fig. 12. It seems deplorable that in regard to such an

<sup>1</sup> This was in reply to a private letter to me very similar to that which he subsequently sent to NATURE. In this reply I asked him to come and examine my specimens for himself, which he did not do.

important subject as the reality or unreality of heterogenesis, persons like Mr. Massee, who could speak authoritatively, should not think it necessary to make personal observations, and should be content to offer in reply to real and prolonged work only loose explanations which will not bear any serious examination.

A further instance of the same lack of care is afforded in the last sentence of Mr. Massee's letter. Referring evidently to my remark (*NATURE*, November 24, 1904, p. 77) as to the very different products that may be met with in the scum forming on an infusion made from unripe grasses as compared with that forming on an ordinary hay infusion, he says:—"As these fungi only develop on fading leaves it was not to be expected that they would appear in infusions of young grass." This sentence must have been penned without the writer having taken the trouble to look at p. 87 of my "Studies in Heterogenesis," to which reference was made when I directed attention to the differences in question. Had he done so he would have seen how little he had explained the differences noted on that and on the following page, and he would also have seen that the most striking difference recorded is the complete absence of Zoogloea masses (spoken of there as "areas") in the scum forming on infusions of unripe grasses. Of course if the Zoogloea masses are not there it is easy for me to understand the absence of the Fungus-germs which, as I maintain, are produced therefrom.

This point, as well as others in Mr. Massee's letter, shows the great importance of bearing in mind two wholly distinct aspects of my observations, corresponding with different stages in the processes described. We have to do (1) with the growth, the individualisation, and the processes of segmentation taking place in masses of Zoogloea. We have also to do (2) with the question of the ultimate destination, or the transformation, of the products of such segmentation. These are two parts of the subject which are to some extent distinct, and are well worthy of further separate consideration.<sup>1</sup>

In conclusion I would ask, Why do the bacteriologists not tell us what they know about Zoogloea—whether they are or are not aware of its developmental tendencies, and why it should undergo processes of minute segmentation, unless such processes are a result of an organising tendency destined to have some definite outcome? Why, again, should it or its segments so often tend to assume a brown colour, while it is still nothing but Zoogloea, either segmented or unsegmented? Again, why, if the brown Zoogloea does not yield the brown Fungus-germs, should there be this constant association of myriads of brown Fungus-germs (in the absence of hyphæ) in association with brown masses of Zoogloea? How can they explain, other than I have done, the actual organisation of a Zoogloea mass, and the stages by which the brown Fungus-germs seem to be formed therein? What process of "infection" in a filtered hay infusion contained in a closed pot could cause thousands of small Zoogloea masses to go simultaneously through similar processes of this kind—producing myriads of brown Fungus-germs—when not a single hypha is anywhere to be found, and when at first no Fungus-germs are to be met with outside the Zoogloea masses themselves? I trust the bacteriologists will vouchsafe to give us some information on these points, or, if they cannot reasonably explain them, that they may be induced to work at the subject, and satisfy themselves that something important can be learned concerning bacteria, even though it be outside their laboratories and by methods other than their own.

H. CHARLTON BASTIAN.

#### Compulsory Greek at Cambridge.

As a corrective to much vague discussion, perhaps the following record of facts may be of interest.

Entering the University of Cambridge in 1886, entirely ignorant of the Greek language, I was, of course, obliged to pass the "Little-go" in order to proceed to the natural sciences tripos. The Greek subjects prescribed were the Gospel of St. Mark, the Pluto of Aristophanes, and the

<sup>1</sup> My further observations on this subject will be found in the February number of the *Annals and Magazine of Natural History*.

usual grammar papers, and, in conjunction with a friend similarly circumstanced to myself, I set to work to "cram" these by as "scientific" methods as we could devise, in order to pass with as little waste of time as possible.

Purchasing a copy of Wordsworth's "Primer of Greek Grammar," we read the nouns, adjectives, and the active voice of *τυπτα*—no more, and then started on the prescribed books. These we translated by aid of a good lexicon, word by word—thus learning the parts of the irregular verbs, which form a favourite subject in the grammar papers. Having been once through the books by this method, we procured the translations, and read these through five or six times, in order to become so familiar with the subject-matter of the books that we could translate most passages easily at sight after making out the leading words in them.

The actual time expended by us in the preparation of Greek for the examination was carefully recorded, and amounted to 105½ working hours, and we passed the examination in the second class, with, I believe, a considerable margin of safety even in Greek. I need hardly add that my present knowledge of the language is *nil*.

JOHN C. WILLIS.

Royal Botanic Gardens, Peradeniya, Ceylon,  
December 28, 1904.

#### Polyhedral Soap-films.

THE fact that polyhedral wire frames can be used for the purpose of forming films across them is well known, but there are some features of this subject, which I have investigated, which may be of interest.

If a frame of wire representing the edges of one of the simpler polyhedra, such as a cube or octahedron, is dipped into soap solution, then on taking it out it will have films attached to its edges and meeting roughly at a point in the centre of the figure, forming a number of pyramids standing on the faces of the figure. If, however, a more complex figure, such as the rhombic dodecahedron or the eicosihedron, be taken, then the effect will be quite different; the film will then simply cover all the faces except the one which was drawn out of the solution first. The former thing will happen if the area of the  $(n-1)$  faces is greater than that required to form the pyramids, while the latter will occur if the reverse is the case.

If, now, in the case of the cube, for instance, after the pyramids have been formed, a film be applied to one of the faces, then a certain amount of air becomes entirely enclosed by film, and the bubble so formed settles in the centre of the frame, forming roughly a cube suspended in the frame by twelve sheets of soap-film. On closer inspection, however, it will be seen that the faces of this cube are convex, thus showing that the air in it is compressed. By inserting a tube this cubical bubble can be inflated or reduced in size, all the time retaining its convexity, so that if thus left in communication with the air it will collapse of its own accord. A little consideration shows the reason for this, namely, that three films meeting one another cannot be in equilibrium unless their planes are inclined to one another at  $120^\circ$ , since the tensions in all three are equal. But since the dihedral angle of a tetrahedron, cube, or octahedron is less than  $120^\circ$ , therefore in these figures the internal polyhedral film must always have convex faces.

From this I expected to get an exact polyhedron with plane faces in the case of the rhombic dodecahedron, since its dihedral angles are all  $120^\circ$ . On trying this it was found to agree remarkably with my assumption, only, as may be gathered from what has gone before, it was not quite so simple to obtain the central bubble as in the former case. After the  $(n-1)$  faces had been covered with film the figure was again immersed so as to displace about one-half the air contained in it, and while thus immersed it was turned round so as to cover the one open face with liquid. On withdrawing it there was seen the plane-faced rhombic dodecahedron. The same result can be obtained by applying a film to the  $n$ th face and then exhausting some of the enclosed air by means of a tube. By using a tube, as in the former cases, the bubble can be enlarged